

by it. In the past, mathematicians have forged out of human experience methods of mechanical and exact development of ideas; they are still doing so and we have every reason to believe that mathematical methods for handling complicated problems where abstraction is undesirable will be available in the future. Our glimpse into the past gives us every assurance that a better understanding of solutions will come as time goes by, but we must expect that understanding to be based on concepts that are still further removed from our every-day experience.

BOTANY.—*New United States grasses.* JASON R. SWALLEN, U. S. Bureau of Plant Industry.¹

Of the eight new species herein described, five are from the collections of W. A. Silveus in Florida (*Andropogon rhizomatus*, *A. niveus*, *A. sericatus*), Texas (*Sporobolus silveanus*), and Arizona (*Sporobolus patens*). *Sporobolus pulvinatus* and *Muhlenbergia villosa* are described from material previously referred to *S. pyramidatus* (Lam.) Hitchc. and *M. thurberi* Rydb., respectively, and *Glyceria cookei* is based on a collection of William Bridge Cooke from the Mount Shasta region of California.

Glyceria cookei Swallen, sp. nov.

Fig. 1

Perennis; culmi 15–30 cm alti, graciles, foliosi, erecti basi decumbentes, glabri; vaginae internodiis multo longiores, inferiores breves superiores elongatae, carinatae, scaberulae, marginibus hyalinis; ligula 5–7 mm longa, hyalina; laminae 3–5 cm longae, 2–3 mm latae, abrupte acutae marginibus scabris; paniculae 6–12 cm longae, simplices; spiculae breviter pedicellatae appressae vel anguste ascendentes, 15–18 mm longae; gluma prima 1.8–2.2 mm longa, obtusa, obscure 1-nervis; gluma secunda 3–3.5 mm longa, obtusa; lemmata 4–4.5 mm longa, 7-nervia, scabra, dentata, marginibus hyalinis; palea lemmate paulo longior, sulcata, bifida carinis alatis; antherae 0.8 mm longae.

Perennial; culms 15–30 cm tall, slender, leafy, erect from a decumbent branching base, glabrous; sheaths much longer than the internodes, the lower ones short, the upper ones somewhat elongate, keeled, scaberulous, the margins thin and hyaline; ligule conspicuous, 5–7 mm long, thin and hyaline; blades 3–5 cm long, 2–3 mm wide, abruptly acute, the margins finely scabrous; panicle 6–12 cm long, erect, unbranched; spikelets short pedicellate on the main axis, appressed or narrowly ascending, 15–18 mm long; first glume 1.8–2.2 mm long, oblong, obtuse, obscurely 1-nerved; second glume 3–3.5 mm long, similar to the first; lemma 4–4.5 mm long, 7-nerved, the nerves prominent, scabrous between the nerves, obtuse, irregularly dentate, the tip and margins hyaline; palea as long as or a little longer than the lemma, sulcate, bifid, the keels narrowly winged; anthers 0.8 mm long.

Type in the herbarium of the U. S. National Arboretum, no. 98480, collected in a wet place on alluvial gravel in the Box Canyon of the Sacramento

¹ Received February 27, 1941.



Figs. 1-3.—New species of United States grasses, plants and panicles, $\times 1$, spikelets, $\times 10$: 1, *Glyceria cookei*; 2, *Muhlenbergia villosa*; 3, *Sporobolus silveanus*. Drawings from the type specimens by Mrs. Frances C. Weintraub.

River near Mount Shasta City, Calif., altitude 3,000 feet, July 12, 1940, by William Bridge Cooke (no. 15312).

Glyceria cookei belongs to the section *Euglyceria*, in which the spikelets are linear and nearly terete. The known species of this group are all rather tall erect grasses with simple flaccid culms and relatively broad elongate blades. This species, however, has short, firm culms, decumbent and branching at the base, with short, narrow, spreading blades. It is evidently most nearly

related to *Glyceria occidentalis* (Piper) J. C. Nels. but differs in the above mentioned characters.

***Muhlenbergia villosa* Swallen, sp. nov.**

Fig. 2

Perennis, rhizomatosa; culmi 10–20 cm alti, ramosi, puberuli, obscure nodulosi; vaginae internodiis breviores, glabrae; ligula 1–2 mm longa decurrens; laminae 2.5–3.5 cm longae, eae ramorum breviores, firmae, involutae, infra glabrae, supra pubescentes, marginibus scabris; paniculae 2–4 cm longae ramis brevibus appressis vel infimis divaricatis usque ad 1 cm longis; spiculae 2–2.5 mm longae breviter pedicellatae, appressae; glumae subaequales, 1–1.6 mm longae, acutae vel subobtusae, 1-nerves; lemma 2–2.5 mm longum, acutum vel mucronatum, marginibus infra medium villosis.

Perennial; culms 10–20 cm tall, wiry, rather freely branching, erect from scaly rhizomes, puberulent, obscurely nodulose roughened; sheaths mostly shorter than the internodes, glabrous; ligule 1–2 mm long, decurrent; blades 2.5–3.5 cm long or those of the shorter branches shorter, firm, involute, glabrous on the lower surface, pubescent on the upper, the margins scabrous; panicles 2–4 cm long, the short closely flowered branches appressed, or the lowermost sometimes stiffly spreading as much as 1 cm long; spikelets 2–2.5 mm long, short pedicellate, appressed; glumes subequal, 1–1.6 mm long, acute or subobtuse, 1-nerved, scabrous on the keel; lemma 2–2.5 mm long, acute or mucronate, the keel and margins villous on the lower half; palea villos on the keels.

Type in the U. S. National Herbarium, no. 1386596, collected 15 miles south of Stanton, Tex., July 11, 1928, by B. C. Tharp (no. 5048).

This species is closely related to *M. villiflora* Hitchc. but is larger in all its parts. The latter is rarely more than 10 cm tall with very wiry culms, arcuate spreading blades 0.5–1 cm long, narrow panicles 0.5–1.5 cm long, and spikelets 1.5–2 mm long. The differences are small, but the characters of *M. villiflora* are very constant through a series of specimens from various localities.

***Sporobolus silveanus* Swallen, sp. nov.**

Fig. 3

Perennis; culmi 85–115 cm alti, dense caespitiosi, erecti, scabri; vaginae internodiis longiores, glabrae vel scaberulae in collo pubescentes, inferiores confertae, superiores elongatae; ligula 0.5 mm longa; laminae usque ad 45 cm longae, involutae, firmae, flexuosae, glabrae, marginibus scabris; paniculae 30–50 cm longae, ramis adscendentibus paucifloris, inferioribus 10–15 cm longis; spiculae 5–6 mm longae, purpureae, pedicellis 5–8 mm longis; gluma prima 3–4.5 mm longa, acuminata, secunda subacuta, lata, 4.5–6 mm longa, in carina scabra; lemma 5–6 mm longum, subacutum; palea lemma aequans, subacuta, obscure carinata; antherae 4 mm longae, nigro-purpureae.

Perennial; culms densely tufted, erect, 85–115 cm tall, scabrous at least toward the summit; leaves mostly crowded toward the base, those of the culm one or two with elongated sheaths; sheaths much longer than the internodes, glabrous or scaberulous, pubescent on the collar, the lower ones firm, straw-colored, shiny, the margins spreading and more or less papery with age; ligule erose-ciliate, 0.5 mm long; blades firm, flat or usually involute, glabrous on both surfaces with scabrous margins, those of the innovations elongate as much as 45 cm long, 1–2 mm wide, curved or flexuous, those of the culms much shorter, the uppermost 7–20 cm long; panicle narrow, mostly 30–50 cm long (or shorter on more slender culms) the branches ascending, rather distant, few-flowered, naked toward the base, the lower ones mostly 10–15 cm long; spikelets 5–6 mm long, purple, the pedicels 5–8 mm

long, appressed or somewhat spreading; glumes acuminate, scabrous on the keel, the first 3–4.5 mm long, 1-nerved, the second broader, 4.5–6 mm long, 3-nerved; lemma 5–6 mm long, subacute; palea about as long as the lemma, subacute, scabrous toward the tip, the keels obscure; anthers about 4 mm long, blackish purple.

Type in the herbarium of the U. S. National Arboretum, no. 98476, collected in open woods about 10 miles northeast of Orange, Tex., September 30, 1940, by W. A. Silveus (no. 6441).

This species is closely related to *Sporobolus floridanus* Chapm. and *S. teretifolius* Harper, the former differing in having flat blades as much as 5 mm wide, more densely flowered panicles, smaller spikelets 4–5 mm long with nearly equal glumes and the latter in having smaller panicles 15–25 cm long, pilose in the axils, and slightly smaller spikelets with a narrower first glume which is usually less than half as long as the second. The long sparsely flowered panicles of large purple spikelets are very striking and characteristic.

Sporobolus pulvinatus Swallen, sp. nov.

Fig. 4

Annuus; culmi 5–30 cm alti, caespitiosi, basi decumbentes, glabri: vaginae internodiis breviores, glabrae, in ore plusminusve hispidae; ligula ciliata, 0.5 mm longa; laminae 4–7 cm longae, 2–5 mm latae, utrinque scabrae, ea suprema multo reducta; paniculae 2–8 cm longae, pyramidatae, ramis verticillatis appressis vel divaricatis, basi nudis, densifloris; spiculae 1.5–1.7 mm longae, breviter pedicellatae, appressae; gluma prima minuta; gluma secunda et lemma aequalia, abrupte acuta vel subobtusa; palea lemma aequans, minute dentata; antherae 0.3 mm longae, pallidae.

Annual; culms 5–30 cm tall in small or rather dense tufts, decumbent spreading at the base, glabrous; sheaths shorter than the internodes, glabrous, more or less hispid at the throat; ligule ciliate, about 0.5 mm long; blades mostly 4–7 cm long, 2–5 mm wide or smaller in depauperate plants, lanceolate-acuminate, scabrous on both surfaces and on the thick white margins, the uppermost much reduced; panicles 2–5 cm or rarely as much as 8 cm long, pyramidal, the branches verticillate, appressed, spreading at maturity, naked at the base, densely flowered, with scattered but rather prominent glandular areas, and a large pulvinus at the base of each; spikelets 1.5–1.7 mm long, short pedicellate, appressed; first glume minute; second glume about as long as the spikelet, abruptly acute or subobtuse; lemma similar to the second glume but somewhat narrower; palea broad, conspicuous, as long as the lemma, minutely dentate; anthers 0.3 mm long, pale or pinkish; caryopsis 1 mm long, asymmetrically obovate, pale lead colored or reddish, the embryo appearing as a blackened area at the base.

Type in the U. S. National Herbarium, no. 997877, collected at Adamana, Ariz., August 6–15, 1903, by David Griffiths (no. 5107).

This species has been confused with *Sporobolus pyramidatus* (Lam.) Hitchc. but is easily distinguished by its annual habit, short flat blades, and abruptly acute or subobtuse second glume and lemma. *S. pyramidatus*, described from South America (as *Agrostis pyramidatus*), is a strong densely tufted perennial with stiff, erect, acuminate blades and spikelets as much as 2 mm long. The second glume and lemma are gradually acute or subacuminate rather than acute or subobtuse, as in *S. pulvinatus*.

Sporobolus pulvinatus is apparently rather common on sandy plains and roadsides of northern Mexico, extending northward to Texas, New Mexico, and Arizona, where it is relatively rare, at least as indicated by herbarium specimens, and southward to Oaxaca. Specimens representing this species are as follows:

TEXAS: El Paso, *M. E. Jones 4338*; without locality, *Reverchon*. NEW MEXICO: Valencia County, 50 miles west of Albuquerque, *John Redd* in 1935 (Soil Conservation Service no. 755); San Ysidro, Sandoval County, *Dean Mahaffey 83*. ARIZONA: Wilcox, *Griffiths 1896*; Benson, *Griffiths 1490*. SONORA: Agiabampo, *Palmer 814* in 1890; Guaymas, *Palmer 696* in 1887; Batamotal, *Orcutt* in 1899; Imeris to Santa Ana via Magdalena, *Griffiths 6856*. CHIHUAHUA: Chihuahua, *Pringle 816*. COAHUILA: Saltillo, *Hitchcock 5580*. TAMAULIPAS: Tampico, *Hitchcock 5789*. SINALOA: Mazatlan, *Purpus 359*. DURANGO: Durango, *Hitchcock 7583*, *Palmer 384* in 1896; Bernejillo, *Johnston 7787*. QUERÉTARO: Querétaro, *Hitchcock 5855*. HIDALGO: Pachuca, *Hitchcock 6758*. ZACATECAS: Villa de Cos, *Johnston 7427*. OAXACA: Tomellin, *Hitchcock 6236*.

Sporobolus patens Swallen, sp. nov.

Fig. 5

Annuus; culmi 10–25 cm alti, graciles, erecti, glabri; vaginae internodiis breviores, glabrae, in ore sparse hispidae, ea suprema elongata aphylla; ligula ciliata, 0.5 mm longa; laminae 1–2 cm longae, 1–2 mm latae, lanceolatae, planae, marginibus scabris; paniculae pyramidales, 2.5–5 cm longae, ramis paucifloris patentibus infimis subverticillatis superioribus alternis, ramulis abrupte patentibus; spiculae 1.8–2 mm longae, pedicellibus divaricatis usque ad 3 mm longis; gluma prima 0.3 mm longa; gluma secunda et lemma aequalia, acuta; palea lemmate paulo brevior, lata, truncata, minute dentata; antherae 0.2–0.3 mm longae; caryopsis 1 mm longa, pallida.

Annual; culms 10–25 cm tall, slender, erect, in small tufts, glabrous; sheaths shorter than the internodes, the upper one elongate almost bladeless, glabrous, sparsely hispid at the throat; ligule ciliate, about 0.5 mm long; blades 1–2 cm long, 1–2 mm wide, lanceolate, flat, scabrous on the margins; panicles pyramidal, 2.5–5 cm long, the slender branches spreading or even reflexed, the lower ones subverticillate, the upper ones scattered, few flowered, the branchlets abruptly spreading; spikelets 1.8–2 mm long, the pedicels slender, spreading, as much as 3 mm long; first glume minute, about 0.3 mm long; second glume and lemma equal, acute, the lemma a little broader than the glume; palea somewhat shorter than the lemma, broad, truncate, minutely dentate; anthers minute, 0.2–0.3 mm long, pinkish; caryopsis 1 mm long, pale.

Type in the U. S. National Herbarium, no. 1723881, collected at Wilcox, Ariz., September 26, 1938, by W. A. Silveus (no. 3504).

Probably closely related to the preceding, differing in having very slender culms, delicate few-flowered panicles, long spreading pedicels, and larger spikelets. The pulvini are inconspicuous and there are no glandular areas on the axis or branches of the panicle.

Andropogon rhizomatus Swallen, sp. nov.

Fig. 6

Perennis, rhizomatosus; culmi 50–70 cm alti, solitarii vel caespitosi, glabri, in parte superiore ramosi, ramis gracilibus appressis vel adscendentibus; vaginae internodiis longiores, obscure carinatae, glabrae, inferiores aphyllae; ligula membranacea, minute erosa, 0.5 mm longa; laminae 10–25 cm longae, 1–3 mm latae, glabrae; spathae angustae inconspicuae; racemi solitarii, 2–3 cm longi, pedunculis gracilibus 3–7 cm longis; rachis tortuosa marginibus villosis; spicula sessilis 5–6 mm longa, gluma prima apice obscure carinata, glabra; lemma fertile 5 mm longum, angustum, arista 8–10 mm longa, geniculata, infra geniculam contorta; spicula pedicellata reducta, 2–3 mm longa, exaristata, pedicello superne ciliato.



Figs. 4-8.—New species of United States grasses, plants and panicles, $\times 1$, spikelets, $\times 10$: 4, *Sporobolus pulvinatus*; 5, *Sporobolus patens*; 6, *Andropogon rhizomatus*; 7, *Andropogon niveus*; 8, *Andropogon sericatus*. Drawings from the type specimens by Mrs. Frances C. Weintraub.

Perennial; culms 50-70 cm tall, slender or rather stout, scattered, or in small dense tufts, erect from short scaly rhizomes, glabrous, rather sparingly branched above the middle, the usually long slender branches appressed or narrowly ascending; sheaths much longer than the internodes, or the upper ones shorter, rounded on the back or obscurely keeled, the lowermost short, crowded, bladeless, but these not always evident; ligule membranaceous,

minutely erose, about 0.5 mm long; blades 10–25 cm long, 1–3 mm wide, flat or loosely involute, glabrous; racemes solitary, 2–3 cm long, partly enclosed or exerted from the very narrow inconspicuous spathes, the peduncles very slender, 3–7 cm long, the rachis tortuous, villous on the margins; sessile spikelet 5–6 mm long, narrow, the first glume rounded on the back, obscurely keeled near the summit, glabrous; fertile lemma 5 mm long, very narrow, awned from about the middle, the awn 8–10 mm long, geniculate, tightly twisted below the bend; pedicellate spikelet very much reduced, inconspicuous, 2–3 mm long, awnless, the pedicel arcuate spreading, villous on the margins above the middle.

Type in the herbarium of the U. S. National Arboretum, no. 98478, collected in shallow rocky soil near Homestead, Fla., October 16, 1940, by W. A. Silveus (no. 6614).

This well-marked species superficially resembles *Andropogon stolonifer* (Nash) Hitchc., which is typically much larger with longer rhizomes, broad, distinctly keeled sheaths, and more numerous racemes which are commonly 4–6 cm long. It is a plant of low rocky or alkaline soil of southern Florida, while *A. stolonifer* is found in sandy woods of northern Florida.

Other collections have been made west of Palm Beach, *Silveus* 6661, and Royal Palm State Park, *Silveus* 6606.

***Andropogon niveus* Swallen, sp. nov.**

Fig. 7

Perennis; culmi graciles 50–65 cm alti, caespitiosi glabri; vaginae carinatae, glabrae, inferiores internodiis longiores, superiores internodiis breviores; ligula membranacea, 1 mm longa; laminae 5–9 cm longae, 1–2 mm latae, divergentes vel reflexae, marginibus scabris; racemi 4–7, 3–4 cm longi, rachi subflexuosa densissime pilosa pilis ca. 2 mm longis; spiculae sessiles 5–6 mm longae, suberectae; gluma prima minute bifida, obscure carinata, glabra; lemma fertile 4 mm longum, lobatum, arista 1 cm longa, geniculata, infra geniculam contorta; spicula pedicellata reducta 3 mm longa.

Perennial; culms slender, 50–65 cm tall, in small rather dense tufts, erect, glabrous; sheaths keeled, glabrous, the lower ones longer, the upper ones shorter than the internodes; ligule membranaceous about 1 mm long; blades 5–9 cm long, 1–2 mm wide, flat, scabrous on the margins, spreading to reflexed; racemes solitary, few to several, 3–4 cm long, terminating the slender, elongate, rather distant branchlets, the rachis nearly straight or somewhat flexuous, the joints and sterile pedicels about 5 mm long, very densely villous, the hairs 2 mm long at the summit becoming gradually shorter toward the base; first glume of sessile spikelet 5–6 mm long, glabrous, minutely bifid, obscurely keeled toward the summit, 2-nerved between the keels; fertile lemma 4 mm long, very deeply lobed, awned from near the base, the awn 1 cm long, geniculate at the middle, tightly twisted below the bend; pedicellate spikelet much reduced, about 3 mm long including the awn; anthers yellow, 2.5 mm long.

Type in the herbarium of the U. S. National Arboretum, no. 98477, collected on sandy land about 15 miles south of Kissimmee, Fla., October 21, 1940, by W. A. Silveus (no. 6684).

This very graceful species is allied to *Andropogon gracilis* Spreng., which can be distinguished by the longer involute blades, more conspicuously hairy racemes, and stouter longer awns as much as 2 cm long. It is rather common in open sandy pineland of central Florida. Other collections than the type have been made in Florida east of Clermont, Lake County, *Silveus* 6704; Gainesville, Alachua County, *Swallen* 5634, 5639; 8 miles east of Dundee,

Polk County, *McFarlin 3707*; Brooksville, Hernando County, *H. R. Reed* in 1933.

***Andropogon sericatus* Swallen, sp. nov.**

Fig. 8

Perennis; culmi graciles, 50–80 cm alti, erecti, caespitosi, in parte superiore multiramosi, ramis gracilibus erectis vel adscendentibus; vaginae glabrae, carinatae, internodiis breviores; ligula membranacea, truncata, 1 mm longa; laminae innovationes subfiliformae, 10–20 cm longae, supra ad basin pilosae, eae culmorum 15–20 cm longae, 2–3 mm latae, conduplicatae marginibus scabris; spathae inconspicuae; pedunculi 4–6 cm longi, gracillimi, curvati; racemi solitarii, 3 cm longi, vix exserti; rachis gracilis, flexuosa, dense pilosa pilis usque ad 7 mm longis; spicula sessilis 5 mm longa, divergens; gluma prima sulcata carinis scabris; lemma fertile 3 mm longum, bilobum, arista 15–20 mm longa, geniculata, infra geniculam contorta; spicula pedicellata reducta, 3–4 mm longa.

Perennial; culms 50–80 cm tall, rather slender, tufted, erect, glabrous, profusely branching in the upper half, the slender branches and racemes forming a somewhat dense but delicate inflorescence; sheaths, except the lower ones, shorter than the internodes, keeled, glabrous; ligule membranaceous, truncate, 1 mm long; blades of the innovations very narrow or subfiliform, 10–20 cm long, long pilose on the upper surface toward the base; culm blades broader, 2–3 mm wide, conduplicate, mostly 15–20 cm long, scabrous on the margins; spathes very inconspicuous; peduncles 4–6 cm long, very slender, curved but becoming straight with age; racemes solitary or rarely paired, 3 cm long, scarcely exerted from the spathes, the rachis slender, flexuous, conspicuously hairy, the hairs at the summit of the joints as much as 7 mm long, gradually shorter downward, the sterile pedicels spreading, hairy like the rachis joints; sessile spikelets 5 mm long, spreading; first glume conspicuously keeled with a deep furrow between the scabrous keels; lemma 3 mm long, bilobed, awned from just below the middle, the awn 15–20 mm long, geniculate, tightly twisted below the bend; pedicellate spikelet very much reduced, 3–4 mm long including the awn.

Type in the herbarium of the U. S. National Arboretum, no. 98479, collected on Ramrod Key, Fla., October 17, 1940, by W. A. Silveus (no. 6633).

The relationship of this grass is not evident. The racemes are mostly solitary as in the section *Schizachyrium*, but occasionally they are paired as in the section *Arthrolophis*, thus breaking down the primary character used to separate *Schizachyrium* as a genus. Superficially this species resembles larger plants of *A. gracilis* Spreng., the racemes of which are fewer and much more conspicuously hairy, and all the blades are involute. The numerous slender branches forming a relatively dense but delicate inflorescence, and the usually solitary, flexuous, silky racemes are characteristic.